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# American Plaice C[illegible] Results from Fall 1999 Survey in NAFO Division 3Ps

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## Abstract

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod and flatfish. The focus in this document is American plaice. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the second GEAC survey to investigate in detail the American plaice catch (following on the 1998 results in CSAS Research Document 1999/059). One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the 1999 trip, set details and length frequencies were logged in the DFO Fisheries Form System (FFS) and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of American plaice abundance and biomass, including age distribution estimates, and interpretation of results are presented. The 1999 results indicate that the strengths of all year classes from 1987 onwards are all increased from the corresponding 1998 survey. The 1989 to 1991 year classes in particular are up noticeably from the 1998 survey. Total plaice abundance and biomass estimates for the 1999 survey are three times larger than for 1998; however, the increases can be accounted for by one stratum area of the survey. Most likely it is a year effect that is the cause of the increases.

## Résumé

Pour améliorer la base de données de recherche sur les pêches pour la sous-division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de morue et de poissons plats effectués à l'automne 1997, de 1998 et 1999. Le présent document porte sur la plie canadienne. Ces travaux ont pour but de créer une série de relevés annuels d'automne dans la sous-division 3Ps pour compléter les activités actuelles d'évaluation des ressources que mène le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés avec l'aide du MPO, qui a fourni des conseils scientifiques pour la conception et la réalisation d'un relevé aléatoire stratifié et des échantillonnages connexes. Les données ainsi recueillies ont été analysées pour le compte du GEAC et en vue de transmettre les résultats au MPO pour qu'il les entre dans ses bases de données et s'en serve dans ses travaux d'évaluation. Il s'agit du deuxième relevé du GEAC qui examine en détail les prises de plie canadienne (pour donner suite aux résultats de 1998 présentés dans le document de recherche 1999/059 du SCÉS). Une sortie effectuée dans le cadre du relevé de 1999 s'est déroulée du 22 novembre au 2 décembre 1999, ce qui correspond aux périodes de sortie des deux années précédentes, soit du 8 au 17 décembre 1997 et du 30 novembre au 12 décembre 1998. Au cours de la sortie de 1999, les détails de la pêche et les fréquences de longueurs ont été enregistrés dans le système de formulaire FFS («Fisheries Forms Systems») du MPO, et des otolithes ont été prélevés pour la détermination de l'âge. Le document présente des statistiques de captures, la distribution des longueurs et des âges, des estimations par analyse stratifiée de l'abondance et de la biomasse, notamment des estimations de la répartition par âge, ainsi que l'interprétation des résultats. Les résultats indiquent que l'importance de toutes les classes d'âge à partir de celle de 1987 a augmenté en 1999 par rapport au relevé correspondant de 1998. En particulier, les classes d'âge de 1989 à 1991 présentent une hausse marquée par rapport au relevé de 1998. Les estimations de l'abondance et de la biomasse totales de la plie pour 1999 sont trois fois plus élevées que pour 1998; toutefois, ces hausses ne sont attribuables qu'à une seule strate du relevé. L'effet d'une année exceptionnelle est probablement à l'origine de ces hausses.

## Introduction

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod and flatfish. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the third such GEAC survey in 3Ps following on the 1997 and 1998 surveys and the second survey in which the American plaice catches have been investigated in detail (following on CSAS Research Document 99/59 [1]). Interest in this survey was directed at cod, American plaice, and witch flounder (grey sole). The 1999 results for cod and witch are presented in companion CSAS Research Documents 2000/024 [2] and 2000/026 [3]. One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging.

Under contract to GEAC, AGRA Earth & Environmental has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

## Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

*Trip 4: Stratified Random Survey*
Trip 4 was carried out from 22 November to 2 December 1999. This time period is consistent with the 1997 and 1998 random stratified survey sets. The *Pennysmart*, the same boat as in 1997/98 and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, American plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. No significant weather or sea events were reported that would have adversely affected the trip success.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock hopper foot gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using NETMIND sensors: bridge display of doorspread, wingspread, and net opening (headline height) was visually monitored and measurements were noted

on the written bridge log for each set every five minutes. The trawl gear and configuration were identical to those used in the 1997 and 1998 surveys.

A total of 90 successful stratified random tow sets were completed. Four sets were unsuccessful.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

*Shore-based Analysis*

The set details and plaice length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Thomas Collier. The sole focus in the work presented here is for plaice.

The plaice were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch numbers and weights were carried out. These are presented in Figures 2a and 2b. Table 1 presents a summary of the plaice set details and catch numbers and weights.

The mean plaice catch for the 90 stratified random sets is 55 fish and a mean catch weight of 36 kg. A catch of plaice was reported in 84 of the 90 successful sets. The largest catch of 1846 plaice and weight 1286 kg was from set 67 in the Halibut Channel at a depth of approximately 163 m. A total of five sets had catches over 100 kg, three sets with catches over 200 kg. The mean plaice weight for all sets (total weight/total numbers) was 0.65 kg per plaice. The median plaice weight of the 84 sets in which plaice were caught was 0.6 kg. The mean plaice weight for the largest catch set 67 was 0.7 kg.

*Gear Performance*

The NETMIND wing sensor was lost initially when the tow gear fouled. The ship returned to Marystown for a replacement sensor and repaired the gear. There are no wings values for sets 1 to 18. There are also no measurements for opening for sets 78 onwards.

For the reported sets, doorspread exhibited a large range of values varying from 50 to just under 100 m, generally increasing in value with depth (Figure 3d). Wingspread was fairly uniform with a mean value of 18.5 m (Figure 3a). This wingspread value is consistent with the 1998 NETMIND mean wingspread value and that used in the 1997 survey. Some net parameter measurements were collected by a SCANMAR system in 1997; however, that system performed with some problems in the later sets. No wingspread data are available from that 1997 survey: the 1997 best estimate of 60 feet has been used for all stratified analyses to date. Figures 3b and 3c present trawl depth and bottom temperature for each set. The values are gleaned from the set sheets.

*Length and Age*

Figure 4 presents the length composition of the 1999 survey and, for comparison, results from the 1998 survey are also shown. For 1999, the fish range in size from 17 cm up to 68 cm. The distribution shows a peak at the mean (39.6 cm), similar to that for 1998. Other than the fact that 1999 shows a somewhat more-defined peak and is a slightly tighter distribution, the length distribution for the two years are almost identical.

Figures 5a and 5b present age composition of the 1999 sampled plaice. Figure 5a presents length versus age distribution. The mean age of 517 sampled plaice was 9.4 years. The youngest and oldest fish were 3 and 17 years. The mode was 9 years.

Figure 5b presents a bar chart of the sampled numbers of plaice at age for 1999 and 1998. The number of sampled plaice are virtually the same for the two years: 515 in 1998; and 517 in 1999. The 1999 distribution shows ages 9, 8, 7 and 10 as the most frequent accounting for roughly 19%, 15%, 13%, and 13% of the total sample set respectively. Ages 6, 13, 12, 11 each account for about 6 to 8%. The age distributions for the two years are similar. Ages 8, 9, 10, and 13 show similar totals with the age 9 total in 1999 being slightly greater than 1998 and the age 10 total in 1998 being slightly larger than that for 1999. About 50% more fish at ages 11 and 12 were sampled in 1998 than 1999. The age 6 and 7 totals for 1999 are roughly double those from 1998.

*Stratified Analysis*

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. A wingspread of 60 feet was used. Table 2 presents the STRAP output of estimated abundance and biomass. The estimated total number of plaice for 3Ps is 44 million (with 95% confidence limits of 2.7 and 85.4 million). The mean number of plaice per standard 1.5 nautical mile tow is 52.9 (with limits of 3.3 and 102.6 fish) compared with 55 in Table 1. The estimated total plaice biomass is 28.7 ktonnes. The mean catch weight per tow is 34.5 kg consistent with Table 1.

All values are up significantly from 1998, uniformly by a factor of 3. The 1999 abundance is up three times from the 1998 value of 12.7 million. The 1999 biomass total is also up three times from the 1998 value of 9.2 ktonnes. The mean set catch and weight values are up from 15 fish and 11 kg in 1998 to 52 fish and 34 kg in 1999.

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 52.9 (consistent with the value in Table 2). The greatest numbers expected are at ages 9 (17.5 fish per tow), 10 (12 fish), and 8 (9.2 fish). Lesser numbers of fish at ages 11, 7, 12, 6, and 13 are also expected.

Table 3b presents a year class summary comparison of abundance STRAP estimates for 1998 and 1999. The 1999 values are those from Table 3a. A large range of year classes is evident for 1999. The 1999 survey indicates the 1987 through 1994 year classes are all up from 1998, year classes 1989 to 1991 being particularly dramatic increases. Only for the older fish and year classes 1986 and prior are the 1999 numbers lower than 1998.

Figures 6a and 6b present the STRAP-estimated mean number of fish per tow and the percent occurrence of mean catch numbers per tow. As already noted with the three-fold increase in estimated numbers from 1998 to 1999, Figure 6a illustrates the increase in numbers for all ages. Figure 6b illustrates that in 1998 there was slightly greater representation for fish aged 11 and older. Age 10 shows a similar percentage in both years, while for ages 9 and below, the 1999 percentages are all up from 1998.

Figures 7a and 7b present age composition by year class as opposed to age. In 1998, the strongest year classes were 1988, 1989, 1986, 1987, and 1990. In 1999, the strongest year classes are 1990, 1989, and 1991. The general observation can be made that in 1999 the estimated numbers for year classes 1988 and prior are all down 50-60% or more, but that for year classes 1989 and since are all up 30-100% or more.

While it is difficult to make comparisons due to the difference in gear types employed, and uncertainties as to how the different gear relate, a comparison with DFO research vessel surveys from 1972 to 1999 suggests that the 1999 GEAC biomass estimate is larger than that in the early-mid 1990s and the highest since 1989 [4]. Ideally one would like to obtain additional points beyond the two years already in the GEAC survey. Until that point it is difficult to compare and assess trends in the time-series.

Tables 4a and 4b present the plaice abundance and biomass estimates by strata for 1998 and 1999, arranged by depth regime. Most of the catches, for both years, appear in the three depth regimes up to 100 fathoms. While the total abundance estimate of 28.7 ktonnes for 1999 is three times larger than that for 1998 as noted above, the set catches from stratum 319 contribute 65% to the 1999 biomass estimate. Removal of stratum 319 for both years brings the estimates to within 20% of each other or 8264 tonnes for 1998 and 9911 tonnes for 1999. The presence of several large catch sets can greatly affect overall totals meanwhile results in the other strata and depth regimes may continue to show and suggest more consistency.

While increases are evident for a range of year classes, such a general population increase is not biologically possible. The large increase from 1998 to 1999 appears to be a year effect with temperature or other population movement factors at play. Other than reporting on the catches and distributions from the survey, it is difficult to draw conclusions on the population.

References

[1] McClintock, J., 1999. "American Plaice and Witch Flounder Catch Results from Surveys in NAFO Division 3Ps." CSAS Research Document 99/59."

[2] McClintock, J., 2000. "Cod Catch Results from Fall 1999 Survey in NAFO Division 3Ps." CSAS Research Document 2000/024."

[3] McClintock, J., 2000. "Witch Flounder Catch Results from Fall 1999 Survey in NAFO Division 3Ps." CSAS Research Document 2000/026."

[4] DFO, 1999. "American Plaice in Subdivision 3Ps." DFO Science Stock Status Report A2-12 (1999).

Table 1 Summary of American Plaice Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 22 Nov - 2 Dec 1999.

| Vessel | *M.V. Pennysmart* Trip | Set | Year | Month | Day | StrLin | Division | Unit Area | Set Location Lat (N) | Set Location Long (W) | Plaice Catch # of Fish | Plaice Catch Weight (kg) | Set Duration (min) | Tow Distance (n.mi.) | Plaice Mean Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | 4 | 1 | 99 | 11 | 22 | 322 | 3Ps | M29 | 46.56 | 55.93 | 24 | 6.5 | 30 | 1.5 | 0.3 |
| 49 | 4 | 2 | 99 | 11 | 23 | 322 | 3Ps | M30 | 46.40 | 55.90 | 7 | 2.5 | 30 | 1.5 | 0.4 |
| 49 | 4 | 3 | 99 | 11 | 23 | 322 | 3Ps | M30 | 46.44 | 55.70 | 4 | 1.0 | 30 | 1.6 | 0.3 |
| 49 | 4 | 4 | 99 | 11 | 23 | 322 | 3Ps | M30 | 46.32 | 55.54 | 6 | 1.6 | 30 | 1.6 | 0.3 |
| 49 | 4 | 5 | 99 | 11 | 23 | 321 | 3Ps | M30 | 46.17 | 55.53 | 4 | 2.0 | 20 | 1.0 | 0.5 |
| 49 | 4 | 6 | 99 | 11 | 23 | 321 | 3Ps | M30 | 46.11 | 55.59 | 7 | 4.0 | 30 | 1.6 | 0.6 |
| 49 | 4 | 7 | 99 | 11 | 23 | 321 | 3Ps | M30 | 46.20 | 55.68 | 5 | 2.0 | 30 | 1.5 | 0.4 |
| 49 | 4 | 8 | 99 | 11 | 23 | 322 | 3Ps | M30 | 46.29 | 55.88 | 5 | 2.0 | 30 | 1.5 | 0.4 |
| 49 | 4 | 9 | 99 | 11 | 23 | 322 | 3Ps | L30 | 46.36 | 56.10 | 13 | 3.0 | 30 | 1.5 | 0.2 |
| 49 | 4 | 10 | 99 | 11 | 23 | 320 | 3Ps | L30 | 46.06 | 56.45 | 1 | 1.3 | 30 | 1.5 | 1.3 |
| 49 | 4 | 11 | 99 | 11 | 23 | 320 | 3Ps | L30 | 46.08 | 56.61 | 2 | 1.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 12 | 99 | 11 | 23 | 314 | 3Ps | L30 | 46.12 | 56.49 | 3 | 2.0 | 30 | 1.6 | 0.7 |
| 49 | 4 | 13 | 99 | 11 | 23 | 314 | 3Ps | L30 | 46.29 | 56.89 | 8 | 10.6 | 30 | 1.4 | 1.3 |
| 49 | 4 | 14 | 99 | 11 | 23 | 314 | 3Ps | L30 | 46.37 | 57.00 | 2 | 4.5 | 30 | 1.5 | 2.3 |
| 49 | 4 | 16 | 99 | 11 | 24 | 314 | 3Ps | K29 | 46.50 | 57.01 | 0 | 0.0 | 30 | 1.5 | |
| 49 | 4 | 17 | 99 | 11 | 24 | 314 | 3Ps | L29 | 46.68 | 56.99 | 2 | 1.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 19 | 99 | 11 | 24 | 311 | 3Ps | K29 | 46.80 | 57.12 | 42 | 21.0 | 30 | 1.4 | 0.5 |
| 49 | 4 | 20 | 99 | 11 | 24 | 310 | 3Ps | K29 | 46.92 | 57.09 | 24 | 16.5 | 30 | 1.5 | 0.7 |
| 49 | 4 | 21 | 99 | 11 | 24 | 310 | 3Ps | K29 | 46.83 | 57.33 | 8 | 5.0 | 30 | 1.5 | 0.6 |
| 49 | 4 | 22 | 99 | 11 | 24 | 313 | 3Ps | K29 | 46.73 | 57.39 | 6 | 3.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 23 | 99 | 11 | 24 | 313 | 3Ps | K29 | 46.62 | 57.51 | 7 | 4.0 | 30 | 1.5 | 0.6 |
| 49 | 4 | 24 | 99 | 11 | 24 | 713 | 3Ps | K30 | 46.48 | 57.64 | 3 | 2.6 | 30 | 1.5 | 0.9 |
| 49 | 4 | 25 | 99 | 11 | 24 | 713 | 3Ps | J30 | 46.24 | 58.06 | 4 | 2.5 | 30 | 1.4 | 0.6 |
| 49 | 4 | 26 | 99 | 11 | 24 | 713 | 3Ps | K30 | 46.10 | 57.91 | 1 | 0.5 | 30 | 1.5 | 0.5 |
| 49 | 4 | 27 | 99 | 11 | 25 | 713 | 3Ps | K30 | 46.02 | 57.78 | 0 | 0.0 | 29 | 1.4 | |
| 49 | 4 | 28 | 99 | 11 | 25 | 713 | 3Ps | K30 | 46.12 | 57.46 | 0 | 0.0 | 30 | 1.5 | |
| 49 | 4 | 29 | 99 | 11 | 25 | 713 | 3Ps | K30 | 46.32 | 57.50 | 1 | 1.0 | 30 | 1.5 | 1.0 |
| 49 | 4 | 30 | 99 | 11 | 25 | 705 | 3Ps | K30 | 46.37 | 57.46 | 9 | 4.5 | 30 | 1.5 | 0.5 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | 4 | 32 | 99 | 11 | 25 | 312 3Ps | K30 | 46.29 | 57.21 | 1 | 0.5 | 30 | 1.5 | 0.5 |
| 49 | 4 | 33 | 99 | 11 | 25 | 312 3Ps | K30 | 46.16 | 57.06 | 101 | 78.5 | 30 | 1.6 | |
| 49 | 4 | 35 | 99 | 11 | 26 | 322 3Ps | M30 | 46.34 | 55.40 | 5 | 1.3 | 30 | 1.5 | 0.3 |
| 49 | 4 | 36 | 99 | 11 | 26 | 323 3Ps | M30 | 46.03 | 55.36 | 22 | 6.5 | 30 | 1.6 | 0.3 |
| 49 | 4 | 37 | 99 | 11 | 26 | 321 3Ps | M30 | 46.00 | 55.43 | 25 | 15.5 | 30 | 1.6 | 0.6 |
| 49 | 4 | 38 | 99 | 11 | 26 | 321 3Ps | M31 | 45.79 | 55.64 | 4 | 2.5 | 30 | 1.6 | 0.6 |
| 49 | 4 | 39 | 99 | 11 | 26 | 320 3Ps | M31 | 45.83 | 55.83 | 22 | 34.0 | 30 | 1.5 | 1.5 |
| 49 | 4 | 40 | 99 | 11 | 26 | 320 3Ps | L31 | 45.82 | 56.13 | 6 | 5.0 | 30 | 1.4 | 0.8 |
| 49 | 4 | 41 | 99 | 11 | 26 | 320 3Ps | L31 | 45.65 | 56.07 | 2 | 2.0 | 30 | 1.5 | 1.0 |
| 49 | 4 | 42 | 99 | 11 | 26 | 321 3Ps | M31 | 45.66 | 55.63 | 149 | 88.5 | 30 | 1.5 | 0.6 |
| 49 | 4 | 43 | 99 | 11 | 26 | 323 3Ps | M31 | 45.62 | 55.23 | 40 | 13.0 | 26 | 1.4 | 0.3 |
| 49 | 4 | 44 | 99 | 11 | 26 | 315 3Ps | M32 | 45.43 | 55.51 | 408 | 285.5 | 30 | 1.5 | 0.7 |
| 49 | 4 | 45 | 99 | 11 | 27 | 320 3Ps | M32 | 45.46 | 55.78 | 30 | 21.5 | 30 | 1.5 | 0.7 |
| 49 | 4 | 46 | 99 | 11 | 27 | 320 3Ps | L32 | 45.42 | 56.05 | 40 | 25.0 | 30 | 1.7 | 0.6 |
| 49 | 4 | 47 | 99 | 11 | 27 | 315 3Ps | L31 | 45.52 | 56.44 | 1 | 1.5 | 30 | 1.6 | 1.5 |
| 49 | 4 | 48 | 99 | 11 | 27 | 316 3Ps | L31 | 45.59 | 56.59 | 20 | 19.0 | 30 | 1.4 | 1.0 |
| 49 | 4 | 49 | 99 | 11 | 27 | 315 3Ps | L31 | 45.63 | 56.46 | 13 | 19.0 | 30 | 1.5 | 1.5 |
| 49 | 4 | 50 | 99 | 11 | 27 | 317 3Ps | L31 | 45.72 | 56.66 | 179 | 108.0 | 30 | 1.6 | 0.6 |
| 49 | 4 | 51 | 99 | 11 | 27 | 706 3Ps | M31 | 45.72 | 55.93 | 19 | 11.0 | 30 | 1.5 | 0.6 |
| 49 | 4 | 52 | 99 | 11 | 27 | 311 3Ps | K30 | 46.17 | 57.12 | 201 | 91.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 53 | 99 | 11 | 27 | 705 3Ps | K30 | 46.04 | 57.18 | 21 | 16.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 54 | 99 | 11 | 27 | 712 3Ps | K31 | 45.74 | 57.11 | 4 | 1.5 | 30 | 1.5 | 0.4 |
| 49 | 4 | 55 | 99 | 11 | 28 | 712 3Ps | K31 | 45.62 | 57.20 | 1 | 1.0 | 30 | 1.3 | 1.0 |
| 49 | 4 | 56 | 99 | 11 | 28 | 712 3Ps | L31 | 45.51 | 56.80 | 0 | 0.0 | 30 | 1.6 | |
| 49 | 4 | 57 | 99 | 11 | 28 | 706 3Ps | L32 | 45.44 | 56.56 | 6 | 9.5 | 30 | 1.5 | 1.6 |
| 49 | 4 | 58 | 99 | 11 | 28 | 706 3Ps | L32 | 45.30 | 56.43 | 6 | 4.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 59 | 99 | 11 | 29 | 322 3Ps | M30 | 46.42 | 55.07 | 5 | 1.0 | 30 | 1.6 | 0.2 |
| 49 | 4 | 60 | 99 | 11 | 29 | 323 3Ps | M30 | 46.14 | 55.02 | 5 | 1.0 | 30 | 1.6 | 0.2 |
| 49 | 4 | 61 | 99 | 11 | 29 | 323 3Ps | N30 | 46.13 | 54.85 | 2 | 0.5 | 30 | 1.4 | 0.3 |
| 49 | 4 | 62 | 99 | 11 | 29 | 323 3Ps | N31 | 45.98 | 54.94 | 26 | 7.0 | 30 | 1.5 | 0.3 |
| 49 | 4 | 63 | 99 | 11 | 29 | 325 3Ps | N31 | 45.75 | 54.82 | 1 | 0.3 | 30 | 1.5 | 0.3 |
| 49 | 4 | 64 | 99 | 11 | 29 | 325 3Ps | N31 | 45.74 | 54.98 | 1 | 0.1 | 30 | 1.5 | 0.1 |
| 49 | 4 | 65 | 99 | 11 | 29 | 319 3Ps | M31 | 45.52 | 55.05 | 81 | 42.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 66 | 99 | 11 | 29 | 319 3Ps | M32 | 45.44 | 55.22 | 290 | 135.0 | 30 | 1.7 | 0.5 |
| 49 | 4 | 67 | 99 | 11 | 29 | 319 3Ps | M32 | 45.25 | 55.30 | 1846 | 1285.6 | 30 | 1.5 | 0.7 |
| 49 | 4 | 68 | 99 | 11 | 29 | 319 3Ps | M32 | 45.23 | 55.31 | 572 | 399.0 | 30 | 1.5 | 0.7 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | 4 | 69 | 99 | 11 | 29 | 315 3Ps | M32 | 45.25 | 55.95 | 38 | 23.0 | 30 | 1.5 | 0.6 |
| 49 | 4 | 70 | 99 | 11 | 29 | 315 3Ps | L32 | 45.11 | 56.09 | 25 | 23.0 | 30 | 1.4 | 0.9 |
| 49 | 4 | 71 | 99 | 11 | 30 | 317 3Ps | L32 | 45.00 | 56.09 | 64 | 40.5 | 30 | 1.5 | 0.6 |
| 49 | 4 | 72 | 99 | 11 | 30 | 316 3Ps | L33 | 44.92 | 56.01 | 6 | 4.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 73 | 99 | 11 | 30 | 707 3Ps | M33 | 44.89 | 55.76 | 4 | 2.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 74 | 99 | 11 | 30 | 708 3Ps | M33 | 44.95 | 55.55 | 0 | 0.0 | 30 | 1.5 | |
| 49 | 4 | 75 | 99 | 11 | 30 | 318 3Ps | M32 | 45.06 | 55.43 | 1 | 0.5 | 30 | 1.5 | 0.5 |
| 49 | 4 | 76 | 99 | 11 | 30 | 318 3Ps | M32 | 45.11 | 55.24 | 3 | 2.5 | 30 | 1.5 | 0.8 |
| 49 | 4 | 77 | 99 | 11 | 30 | 707 3Ps | M32 | 45.05 | 55.23 | 4 | 2.5 | 30 | 1.6 | 0.6 |
| 49 | 4 | 78 | 99 | 11 | 30 | 319 3Ps | M32 | 45.19 | 55.05 | 119 | 73.5 | 30 | 1.5 | 0.6 |
| 49 | 4 | 79 | 99 | 11 | 30 | 319 3Ps | N32 | 45.20 | 54.81 | 169 | 94.5 | 30 | 3.0 | 0.6 |
| 49 | 4 | 80 | 99 | 11 | 30 | 708 3Ps | N32 | 45.00 | 54.58 | 1 | 0.5 | 30 | 1.4 | 0.5 |
| 49 | 4 | 81 | 99 | 12 | 1 | 325 3Ps | N32 | 45.35 | 54.70 | 8 | 6.0 | 30 | 1.6 | 0.8 |
| 49 | 4 | 82 | 99 | 12 | 1 | 325 3Ps | N31 | 45.56 | 54.77 | 1 | 0.3 | 30 | 1.4 | 0.3 |
| 49 | 4 | 83 | 99 | 12 | 1 | 325 3Ps | N31 | 45.55 | 54.70 | 2 | 1.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 84 | 99 | 12 | 1 | 326 3Ps | N31 | 45.77 | 54.43 | 6 | 2.5 | 30 | 1.6 | 0.4 |
| 49 | 4 | 85 | 99 | 12 | 1 | 326 3Ps | N31 | 45.82 | 54.38 | 1 | 0.2 | 30 | 1.5 | 0.2 |
| 49 | 4 | 86 | 99 | 12 | 1 | 325 3Ps | N30 | 46.03 | 54.51 | 1 | 0.6 | 30 | 1.5 | 0.6 |
| 49 | 4 | 87 | 99 | 12 | 1 | 324 3Ps | N30 | 46.28 | 54.62 | 2 | 1.0 | 30 | 1.5 | 0.5 |
| 49 | 4 | 88 | 99 | 12 | 1 | 324 3Ps | N29 | 46.53 | 54.61 | 1 | 0.2 | 30 | 1.5 | 0.2 |
| 49 | 4 | 89 | 99 | 12 | 1 | 324 3Ps | N29 | 46.61 | 54.58 | 3 | 1.2 | 30 | 1.5 | 0.4 |
| 49 | 4 | 90 | 99 | 12 | 2 | 322 3Ps | M30 | 46.44 | 55.12 | 2 | 0.5 | 30 | 1.3 | 0.3 |
| 49 | 4 | 91 | 99 | 12 | 2 | 321 3Ps | M30 | 46.11 | 55.98 | 0 | 0.0 | 30 | 1.5 | |
| 49 | 4 | 92 | 99 | 12 | 2 | 320 3Ps | L31 | 45.93 | 56.08 | 16 | 12.0 | 30 | 1.5 | 0.8 |
| 49 | 4 | 93 | 99 | 12 | 2 | 315 3Ps | M31 | 45.56 | 55.48 | 88 | 65.0 | 30 | 1.5 | 0.7 |
| 49 | 4 | 94 | 99 | 12 | 2 | 319 3Ps | M31 | 45.52 | 55.37 | 29 | 10.0 | 30 | 1.5 | 0.3 |

| | | | | | |
|---|---|---|---|---|---|
| Minimum | 0.0 | 0.0 | 20.0 | 1.0 | 0.1 |
| Maximum | 1846.00 | 1285.57 | 30.00 | 3.00 | 2.25 |
| Mean | 54.97 | 35.64 | 29.83 | 1.52 | 0.65 |
| Median | 6.00 | 2.55 | 30.00 | 1.50 | 0.59 |
| Standard Error | 2.32 | 1.61 | 0.01 | 0.00 | 0.00 |
| Total | 4947.00 | 3207.19 | 2685.00 | 136.50 | 52.70 |
| Count | 90 | 90 | 90 | 90 | 84 |

## Table 2 Stratified Analysis Estimated Plaice Abundance and Biomass

PLAICE GEAC 3PS 1999 No Zone
ANALYSIS FOR TRIP 4 1999 VESSEL 49 ICNAF 3P

NUMBERS

| STRATUM | NO.SETS | TOTAL | AV./SET | UNITS | TOTAL NO | VAR. |
|---|---|---|---|---|---|---|
| 310 | 2 | 32.00 | 16.00 | 9255. | 148087. | 128.00 |
| 311 | 2 | 246.00 | 123.00 | 17903. | 2202046. | 12168.00 |
| 312 | 2 | 95.69 | 47.84 | 16281. | 778964. | 4388.67 |
| 313 | 2 | 13.00 | 6.50 | 11147. | 72456. | 0.50 |
| 314 | 5 | 15.38 | 3.08 | 61748. | 189985. | 10.51 |
| 315 | 6 | 574.72 | 95.79 | 52357. | 5015157. | 24297.64 |
| 316 | 2 | 27.43 | 13.71 | 11147. | 152874. | 119.02 |
| 317 | 2 | 231.81 | 115.91 | 11620. | 1346823. | 5388.52 |
| 318 | 2 | 4.00 | 2.00 | 8715. | 17430. | 2.00 |
| 319 | 7 | 2987.38 | 426.77 | 66477. | 28370252. | 425692.84 |
| 320 | 8 | 114.72 | 14.34 | 79988. | 1147061. | 184.41 |
| 321 | 7 | 193.75 | 27.68 | 73503. | 2034454. | 2917.62 |
| 322 | 9 | 70.37 | 7.82 | 94648. | 740048. | 45.85 |
| 323 | 5 | 96.31 | 19.26 | 47020. | 905727. | 277.37 |
| 324 | 3 | 6.00 | 2.00 | 33374. | 66747. | 1.00 |
| 325 | 6 | 13.57 | 2.26 | 63775. | 144252. | 6.74 |
| 326 | 2 | 6.63 | 3.31 | 11215. | 37148. | 10.70 |
| 705 | 2 | 30.00 | 15.00 | 13174. | 197607. | 72.00 |
| 706 | 3 | 31.00 | 10.33 | 28509. | 294597. | 56.33 |
| 707 | 2 | 7.75 | 3.88 | 4999. | 19372. | 0.03 |
| 708 | 2 | 1.07 | 0.54 | 8512. | 4560. | 0.57 |
| 712 | 3 | 5.15 | 1.72 | 49385. | 84840. | 4.24 |
| 713 | 6 | 9.29 | 1.55 | 57492. | 88975. | 3.00 |

| | TOTAL | TOTAL UPPER | LOWER | AVERAGE MEAN | UPPER | LOWER |
|---|---|---|---|---|---|---|
| | 44059456. | 85391336. | 2727576. | 52.94 | 102.60 | 3.28 |

EFFECTIVE DEGREES OF FREEDOM= 6 STUDENTS T-VALUE= 2.45 ALPHA=0.05

WEIGHTS

| STRATUM | NO.SETS | TOTAL | AV./SET | UNITS | TOTAL NO | VAR. |
|---|---|---|---|---|---|---|
| 310 | 2 | 21.50 | 10.75 | 9255. | 99496. | 66.13 |
| 311 | 2 | 113.50 | 56.75 | 17903. | 1015985. | 2346.13 |
| 312 | 2 | 74.09 | 37.05 | 16281. | 603176. | 2671.35 |
| 313 | 2 | 7.00 | 3.50 | 11147. | 39015. | 0.50 |
| 314 | 5 | 19.23 | 3.85 | 61748. | 237509. | 20.26 |
| 315 | 6 | 418.55 | 69.76 | 52357. | 3652349. | 11607.46 |
| 316 | 2 | 24.86 | 12.43 | 11147. | 138542. | 125.72 |
| 317 | 2 | 141.75 | 70.88 | 11620. | 823563. | 1845.28 |
| 318 | 2 | 3.00 | 1.50 | 8715. | 13072. | 2.00 |
| 319 | 7 | 1976.41 | 282.34 | 66477. | 18769336. | 212921.38 |
| 320 | 8 | 99.67 | 12.46 | 79988. | 996515. | 149.10 |
| 321 | 7 | 114.13 | 16.30 | 73503. | 1198359. | 1035.89 |
| 322 | 9 | 19.20 | 2.13 | 94648. | 201937. | 3.30 |
| 323 | 5 | 28.50 | 5.70 | 47020. | 267973. | 29.73 |
| 324 | 3 | 2.40 | 0.80 | 33374. | 26699. | 0.28 |
| 325 | 6 | 7.90 | 1.32 | 63775. | 83932. | 4.56 |
| 326 | 2 | 2.54 | 1.27 | 11215. | 14264. | 2.30 |
| 705 | 2 | 21.00 | 10.50 | 13174. | 138325. | 72.00 |
| 706 | 3 | 25.00 | 8.33 | 28509. | 237578. | 11.58 |
| 707 | 2 | 4.34 | 2.17 | 4999. | 10858. | 0.06 |
| 708 | 2 | 0.54 | 0.27 | 8512. | 2280. | 0.14 |
| 712 | 3 | 2.65 | 0.88 | 49385. | 43686. | 0.62 |
| 713 | 6 | 6.78 | 1.13 | 57492. | 64952. | 1.51 |

LOWER CONFIDENCE LIMIT IS LESS THAN OR EQUAL TO ZERO
****-VARIANCE TOO LARGE FOR VALID CONFIDENCE INTERVAL AT THI VALUE OF ALPHA-****

| | TOTAL | TOTAL UPPER | LOWER | AVERAGE MEAN | UPPER | LOWER |
|---|---|---|---|---|---|---|
| | 28679400. | 57789684. | -430885. | 34.46 | 69.44 | -0.52 |

EFFECTIVE DEGREES OF FREEDOM= 6 STUDENTS T-VALUE= 2.45 ALPHA=0.05

## Table 3a Stratified Analysis Plaice Age Composition, Numbers per Standard Tow

PLAICE GEAC 1999 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 4 1999
VESSEL 49
ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE
SPECIES:SPECIES 0889
SEX:COMBINED

| AGE IN YEARS | TOTAL NUMBERS | UPPER LIMIT | LOWER LIMIT | MEAN PER TOW | UPPER LIMIT | LOWER LIMIT | D.F. |
|---|---|---|---|---|---|---|---|
| 0.0 | 0. | 0. | 0. | 0.00 | 0.00 | 0.00 | 0 |
| 1.0 | 0. | 0. | 0. | 0.00 | 0.00 | 0.00 | 0 |
| 2.0 | 0. | 0. | 0. | 0.00 | 0.00 | 0.00 | 0 |
| 3.0 | 10516. | 34767. | -13734. | 0.01 | 0.04 | -0.02 | 8 |
| 4.0 | 0. | 0. | 0. | 0.00 | 0.00 | 0.00 | 0 |
| 5.0 | 228842. | 344519. | 113165. | 0.27 | 0.41 | 0.14 | 14 |
| 6.0 | 1234039. | 1856205. | 611873. | 1.48 | 2.23 | 0.74 | 8 |
| 7.0 | 3093982. | 5087500. | 1100464. | 3.72 | 6.11 | 1.32 | 7 |
| 8.0 | 7668834. | 13200619. | 2137049. | 9.21 | 15.86 | 2.57 | 7 |
| 9.0 | 14519088. | 28981294. | 56882. | 17.45 | 34.82 | 0.07 | 6 |
| 10.0 | 9958315. | 21537216. | -1620586. | 11.97 | 25.88 | -1.95 | 6 |
| 11.0 | 3683693. | 7944850. | -577464. | 4.43 | 9.55 | -0.69 | 6 |
| 12.0 | 2195605. | 4554666. | -163456. | 2.64 | 5.47 | -0.20 | 6 |
| 13.0 | 890513. | 1438205. | 342821. | 1.07 | 1.73 | 0.41 | 9 |
| 14.0 | 430590. | 625873. | 235307. | 0.52 | 0.75 | 0.28 | 20 |
| 15.0 | 68879. | 110768. | 26989. | 0.08 | 0.13 | 0.03 | 10 |
| 16.0 | 29300. | 56748. | 1851. | 0.04 | 0.07 | 0.00 | 6 |
| 17.0 | 29556. | 57526. | 1587. | 0.04 | 0.07 | 0.00 | 11 |
| UNKNOWN | 0. | 0. | 0. | 0.00 | 0.00 | 0.00 | 0 |
| TOTAL | 44041744. | 85365408. | 2718087. | 52.92 | 102.57 | 3.27 | 6 |

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE
CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE
TABLE IS LESS THAN OR EQUAL TO ZERO. VARIANCE IS TOO LARGE FOR
VALID CONFIDENCE LIMITS ****

## Table 3b Stratified Analysis Estimated Plaice Abundance Year Class Distribution: Comparison for 1998-1999

| | 3Ps Plaice Estimates | | | |
|---|---|---|---|---|
| | "number" abundance (millions of fish) | | Mean #fish/tow | |
| Year Class | 1998 | 1999 | 1998 | 1999 |
| 1994 | 0.03 | 0.23 | 0.03 | 0.27 |
| 1993 | 0.10 | 1.23 | 0.12 | 1.48 |
| 1992 | 0.26 | 3.09 | 0.31 | 3.72 |
| 1991 | 0.60 | 7.67 | 0.72 | 9.21 |
| 1990 | 1.62 | 14.52 | 1.94 | 17.45 |
| 1989 | 2.11 | 9.96 | 2.53 | 11.97 |
| 1988 | 2.77 | 3.68 | 3.33 | 4.43 |
| 1987 | 1.64 | 2.20 | 1.97 | 2.64 |
| 1986 | 1.73 | 0.89 | 2.08 | 1.07 |
| 1985 | 0.91 | 0.43 | 1.09 | 0.52 |
| 1984 | 0.40 | 0.07 | 0.49 | 0.08 |

Table 4a Plaice abundance estimates (thousands of fish )
from GEAC surveys in NAFO Division 3Ps from 1998-1999

| Depth range (fathoms) | Strata | Vessel Trip #Sets Mean Date sq. mi. | Pennysmart 3 86 6-Dec 1998 | Pennysmart 4 90 27-Nov 1999 |
|---|---|---|---|---|
| <30 | 314 | 974 | 198 | 190 |
| | 320 | 1320 | 3020 | 1147 |
| | | Subtotal | 3218 | 1337 |
| 31-50 | 312 | 272 | 147 | 779 |
| | 315 | 827 | 2838 | 5015 |
| | 321 | 1189 | 210 | 2034 |
| | 325 | 944 | 53 | 144 |
| | 326 | 166 | 0 | 37 |
| | | Subtotal | 3248 | 8009 |
| 51-100 | 311 | 317 | 63 | 2202 |
| | 317 | 193 | 1482 | 1349 |
| | 319 | 984 | 1947 | 28370 |
| | 322 | 1567 | 414 | 740 |
| | 323 | 696 | 263 | 906 |
| | 324 | 494 | 11 | 67 |
| | | Subtotal | 4180 | 33634 |
| 101-150 | 310 | 170 | 440 | 148 |
| | 313 | 165 | 418 | 72 |
| | 316 | 189 | 50 | 153 |
| | 318 | 129 | 84 | 17 |
| | | Subtotal | 992 | 390 |
| 151-200 | 705 | 195 | 224 | 198 |
| | 706 | 476 | 475 | 295 |
| | 707 | 74 | 117 | 19 |
| | | Subtotal | 816 | 512 |
| 201-300 | 708 | 126 | 21 | 4 |
| | 712 | 731 | 16 | 85 |
| | 713 | 851 | 211 | 89 |
| | | Subtotal | 248 | 178 |
| | Total [1] | | 12,702 | 44,060 |

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

Table 4b Plaice biomass estimates (t)
from GEAC surveys in NAFO Division 3Ps from 1998-1999

| Depth range (fathoms) | Strata | Vessel Trip #Sets Mean Date sq. mi. | Pennysmart 3 86 6-Dec 1998 | Pennysmart 4 90 27-Nov 1999 |
|---|---|---|---|---|
| <30 | 314 | 974 | 116 | 238 |
| | 320 | 1320 | 3030 | 997 |
| | | Subtotal | 3146 | 1235 |
| 31-50 | 312 | 272 | 163 | 603 |
| | 315 | 827 | 1671 | 3652 |
| | 321 | 1189 | 176 | 1198 |
| | 325 | 944 | 41 | 84 |
| | 326 | 166 | 0 | 14 |
| | | Subtotal | 2051 | 5551 |
| 51-100 | 311 | 317 | 43 | 1016 |
| | 317 | 193 | 1076 | 824 |
| | 319 | 984 | 940 | 18769 |
| | 322 | 1567 | 131 | 202 |
| | 323 | 696 | 67 | 268 |
| | 324 | 494 | 11 | 27 |
| | | Subtotal | 2268 | 21106 |
| 101-150 | 310 | 170 | 273 | 99 |
| | 313 | 165 | 344 | 39 |
| | 316 | 189 | 32 | 139 |
| | 318 | 129 | 78 | 13 |
| | | Subtotal | 727 | 290 |
| 151-200 | 705 | 195 | 144 | 138 |
| | 706 | 476 | 635 | 238 |
| | 707 | 74 | 60 | 11 |
| | | Subtotal | 839 | 387 |
| 201-300 | 708 | 126 | 9 | 2 |
| | 712 | 731 | 3 | 44 |
| | 713 | 851 | 161 | 65 |
| | | Subtotal | 173 | 111 |
| | Total [1] | | 9,204 | 28,680 |

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.

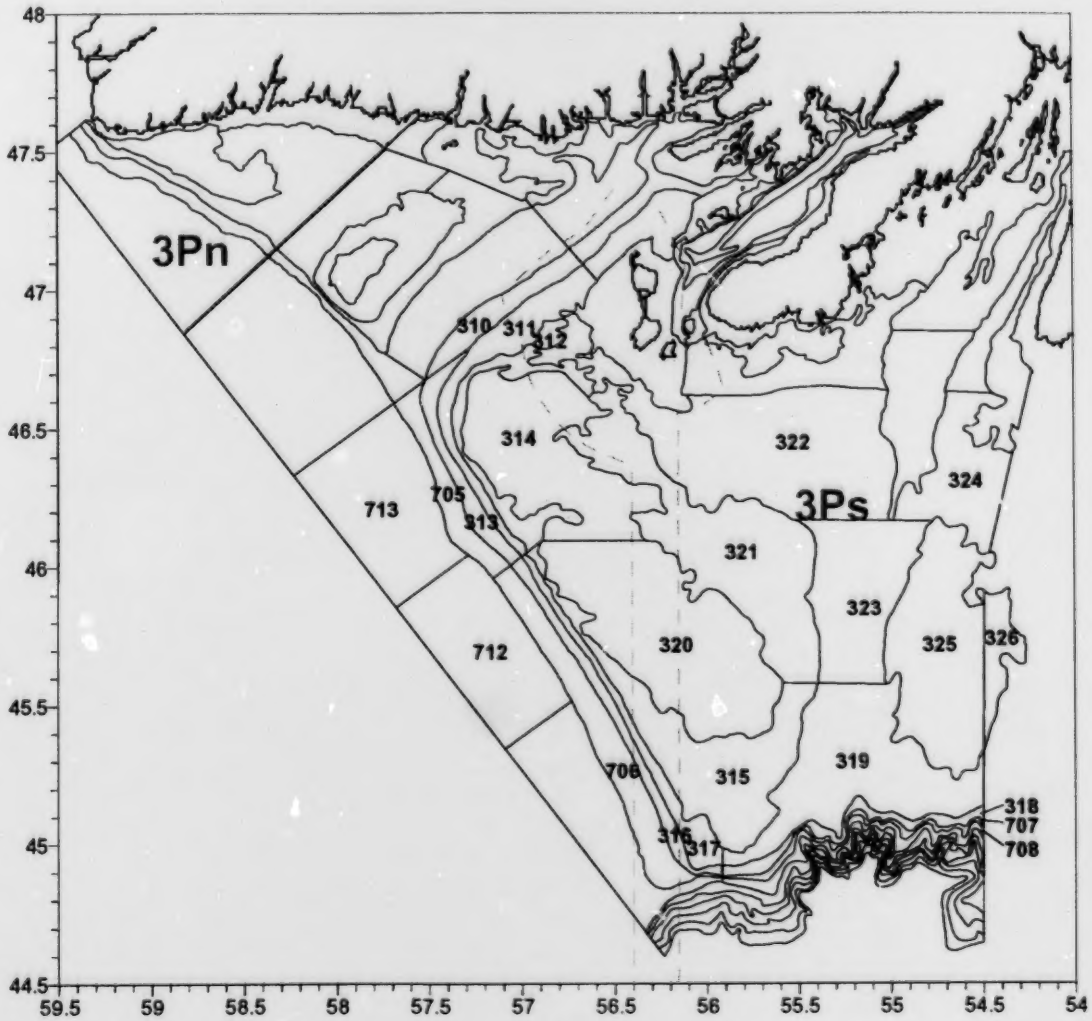


Figure 1 Stratum boundaries within NAFO Division 3P.
Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps.
Dashed line is boundary of French economic zone which was not surveyed.

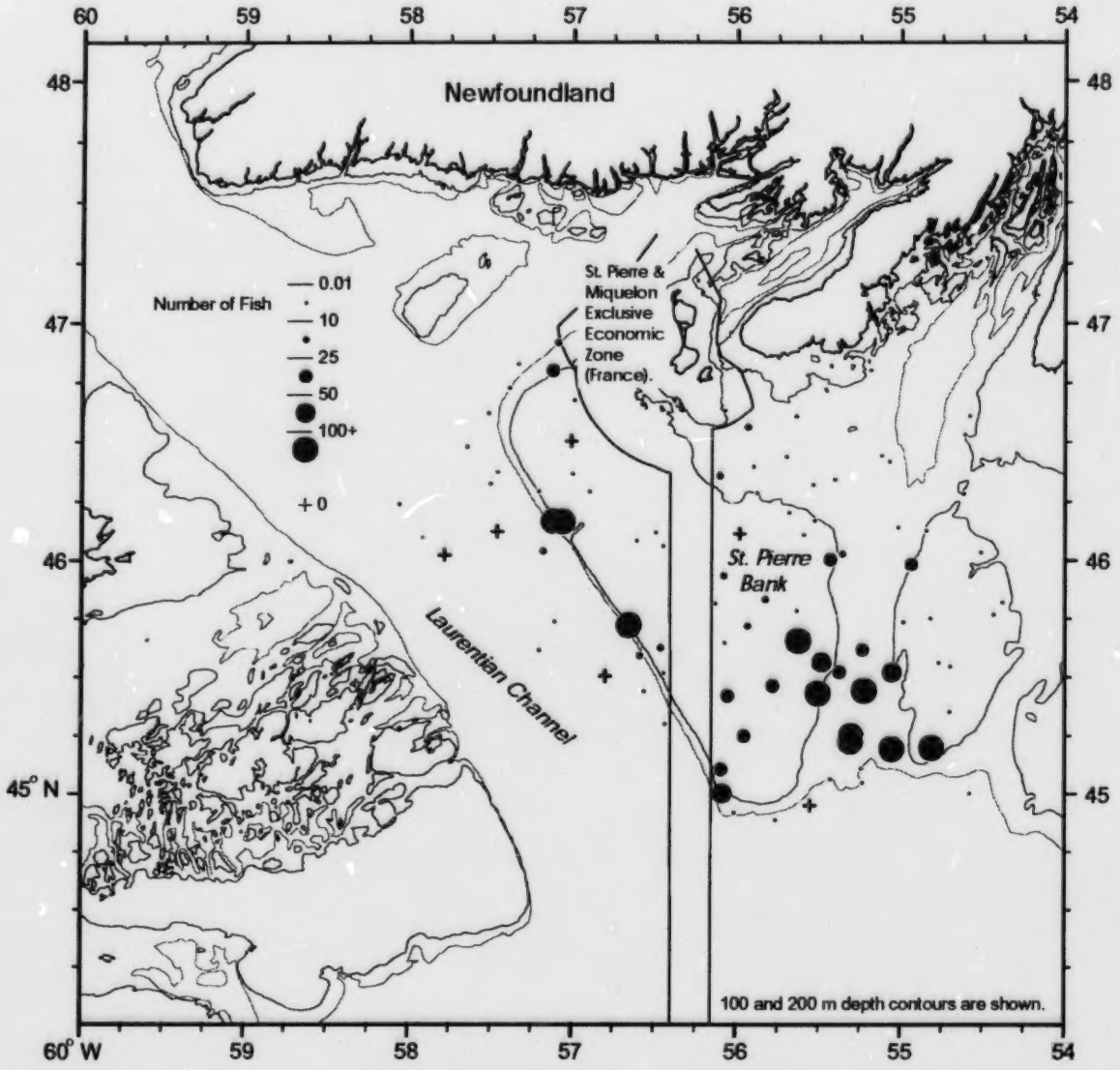


Figure 2a American Plaice Catch Distribution: Number of Fish, from Pennysmart Trip #4 Stratified Random Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

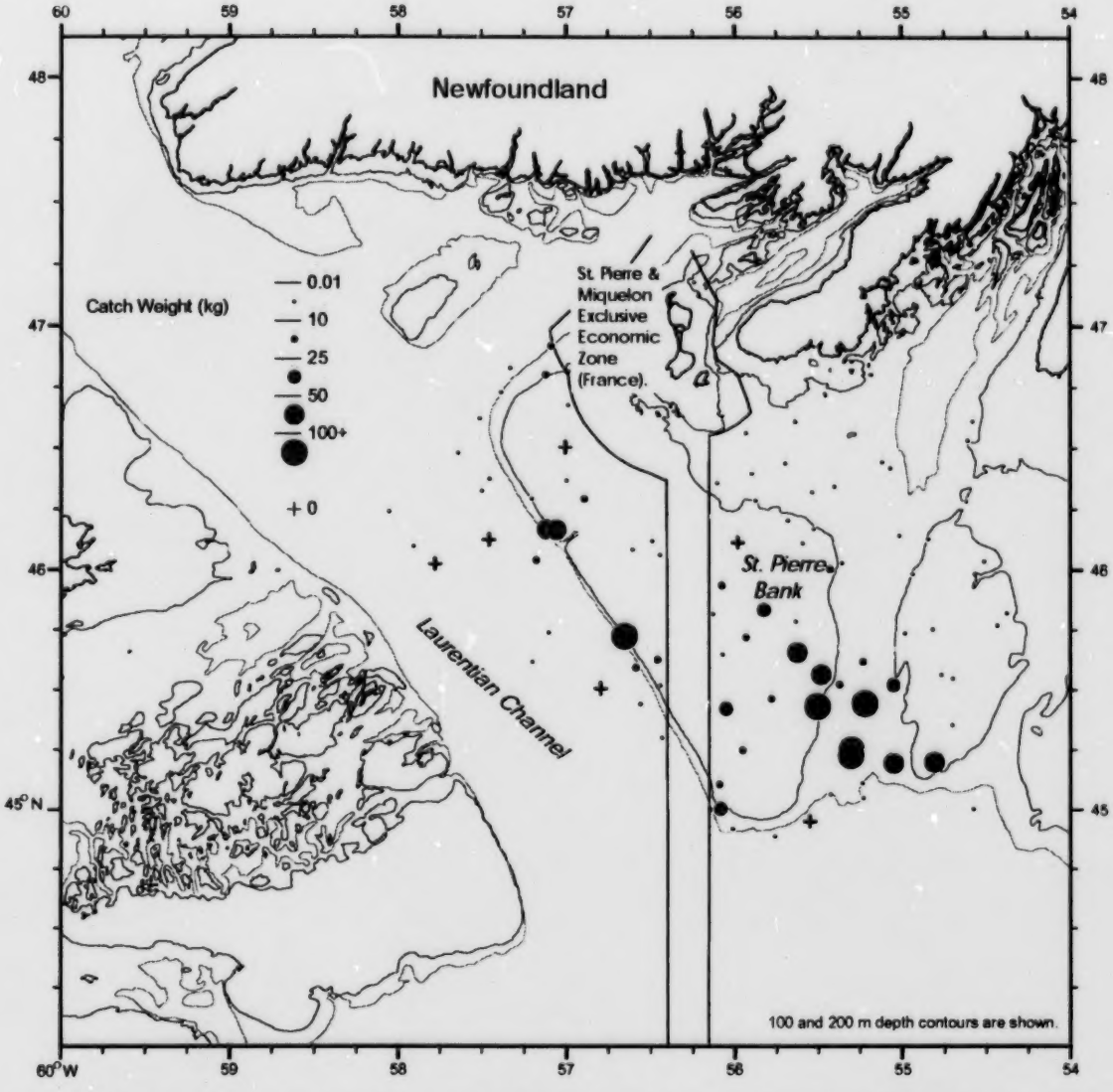


Figure 2b American Plaice Catch Distribution: Catch Weight, from Pennysmart Trip #4 Stratified Random Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

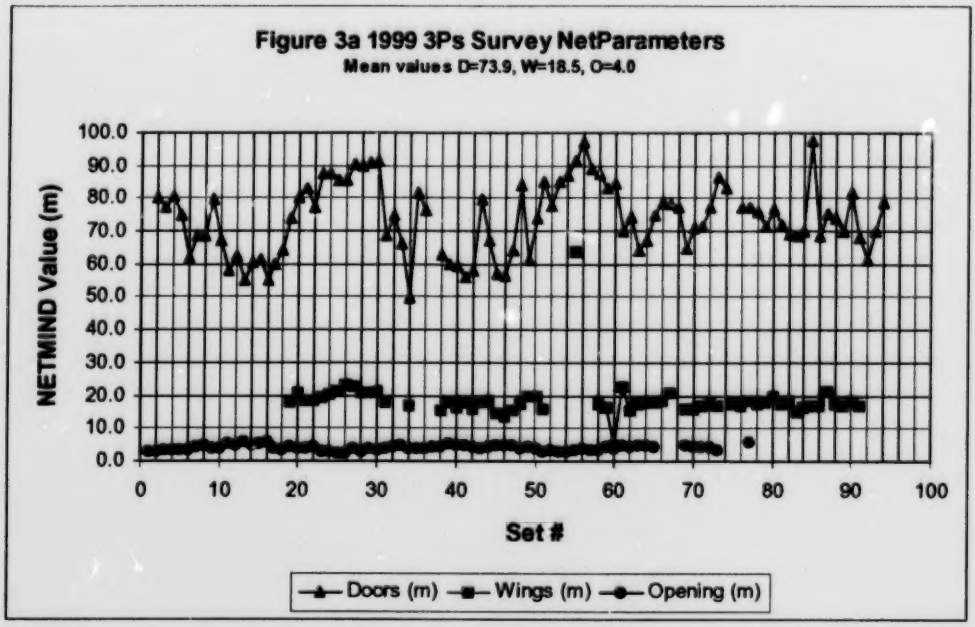
Figure 3a 1999 3Ps Survey NetParameters
Mean values D=73.9, W=18.5, O=4.0
NETMIND Value (m)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
10
20
30
40
50
60
70
80
90
100
Set #
Doors (m)
Wings (m)
Opening (m)

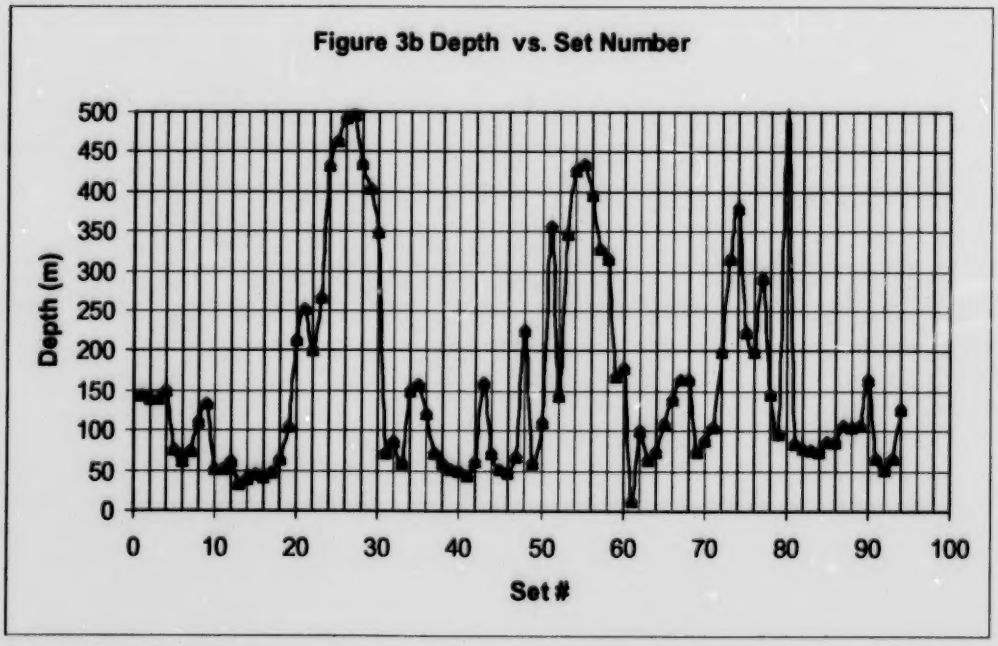
Figure 3b Depth vs. Set Number
Depth (m)
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Set #

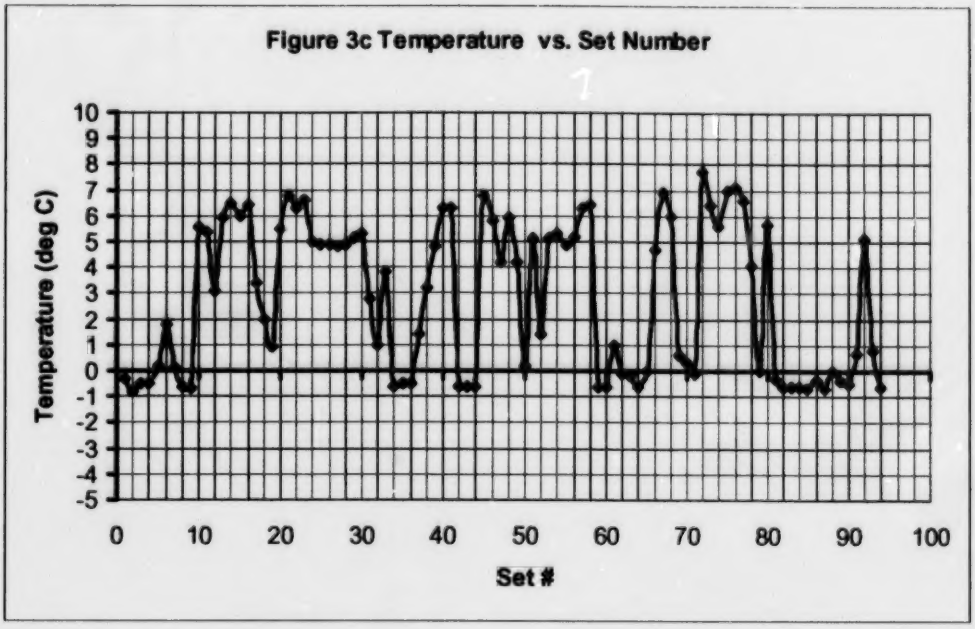
Figure 3c Temperature vs. Set Number
Temperature (deg C)
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
10
20
30
40
50
60
70
80
90
100
Set #

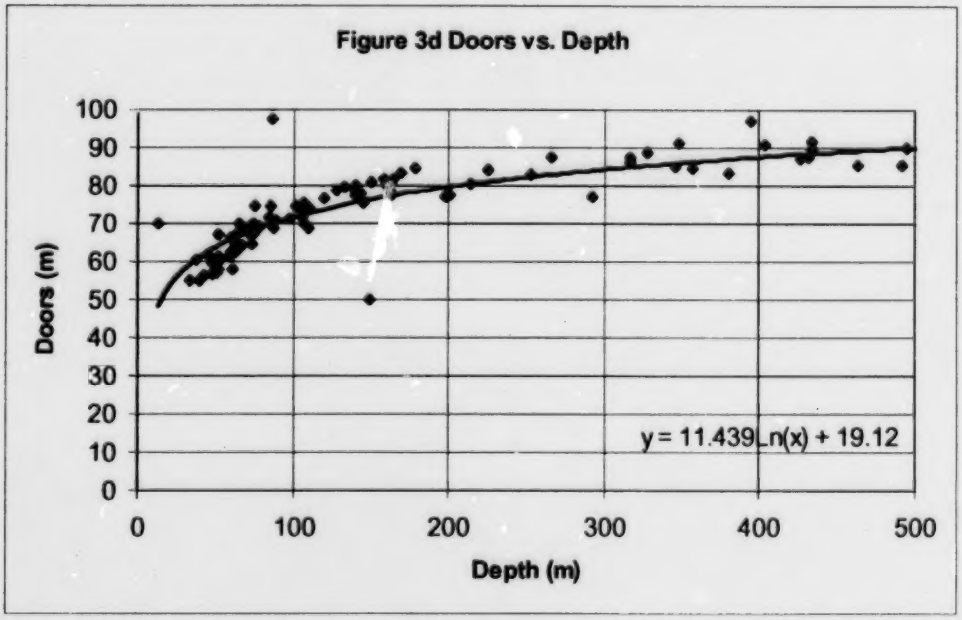
Figure 3d Doors vs. Depth
Doors (m)
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
Depth (m)
y = 11.439Ln(x) + 19.12

Figure 4 Length Composition of Plaice
(3Ps Stratified Random Surveys 1998-1999)

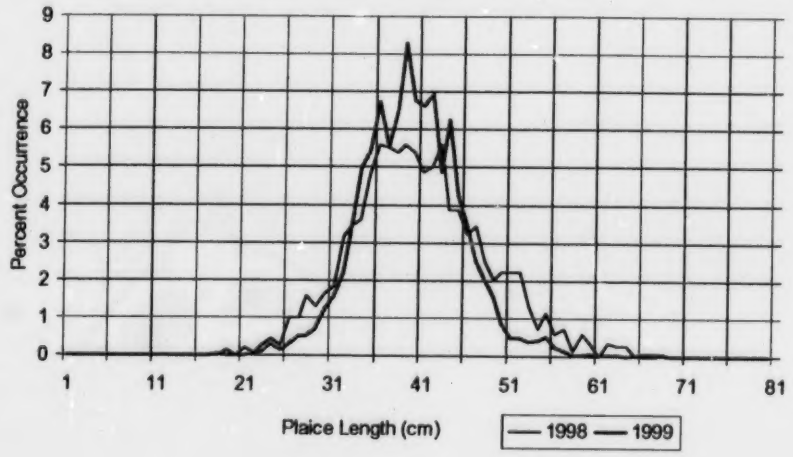

**Figure 5a Plaice Age-LengthComposition**
3Ps 1999 (517 samples)

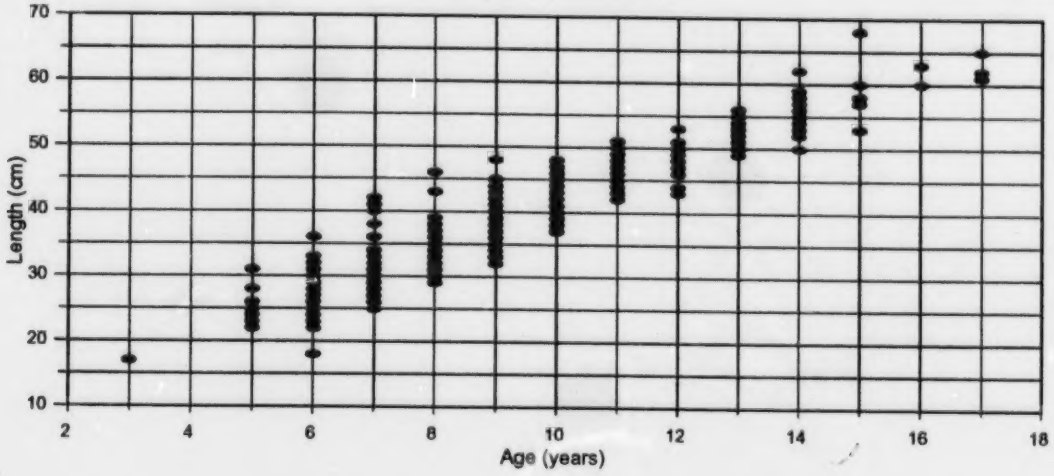


Figure 5b Age Composition of Plaice
3Ps Sampled Plaice

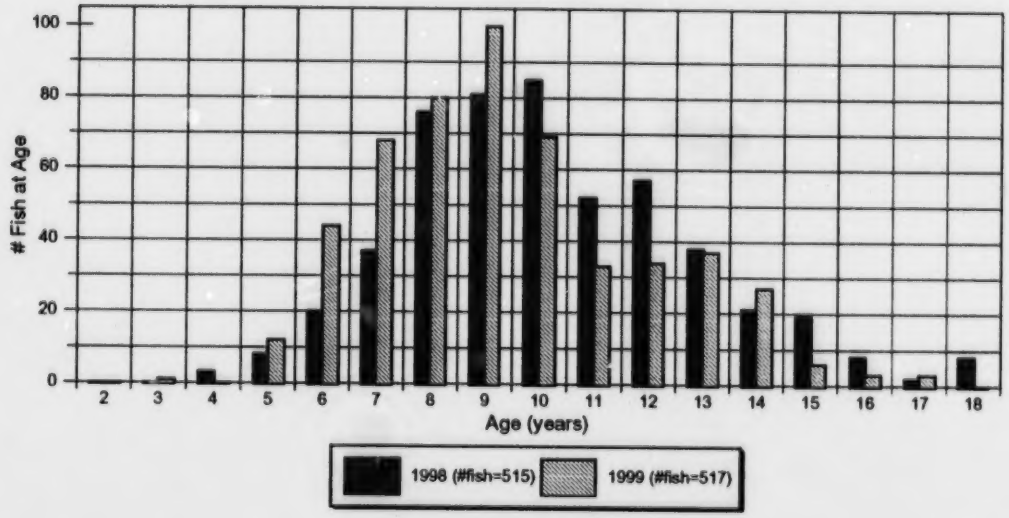

Figure 6a Age Composition of Plaice
Estimated Mean #s per tow (3Ps)

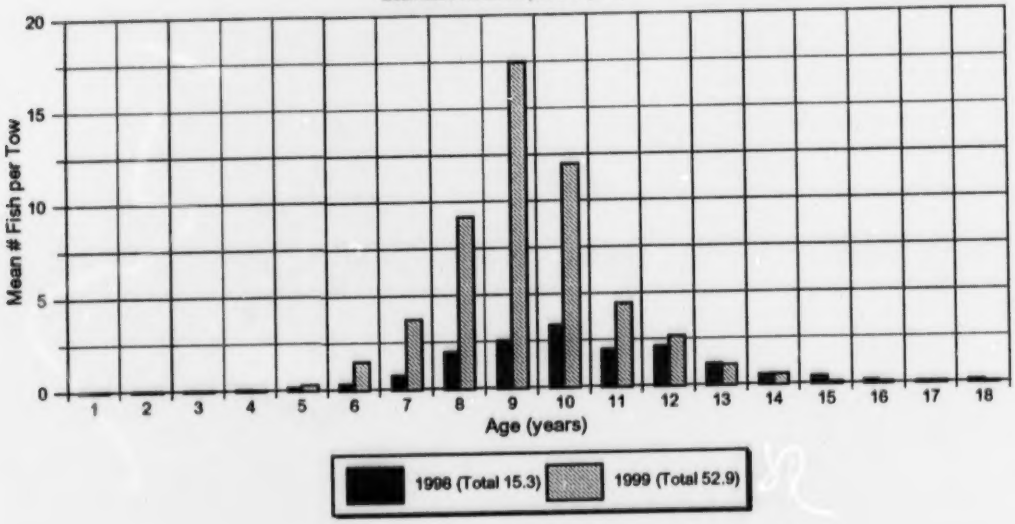


Figure 6b Age Composition of Plaice
Estimated % Total Mean #s per tow(3Ps)

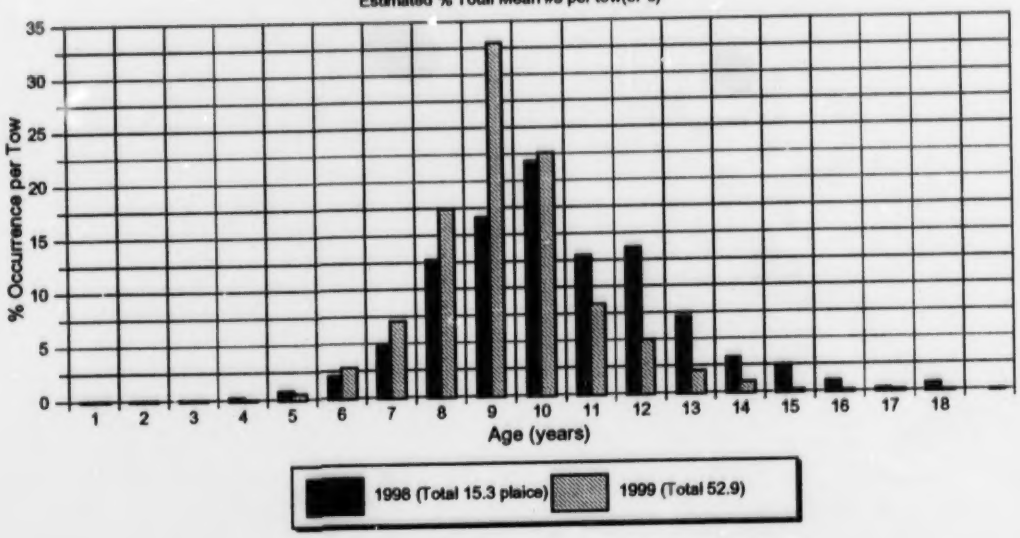

Figure 7a Year Class Composition
3Ps Plaice Estimated Mean #s per tow

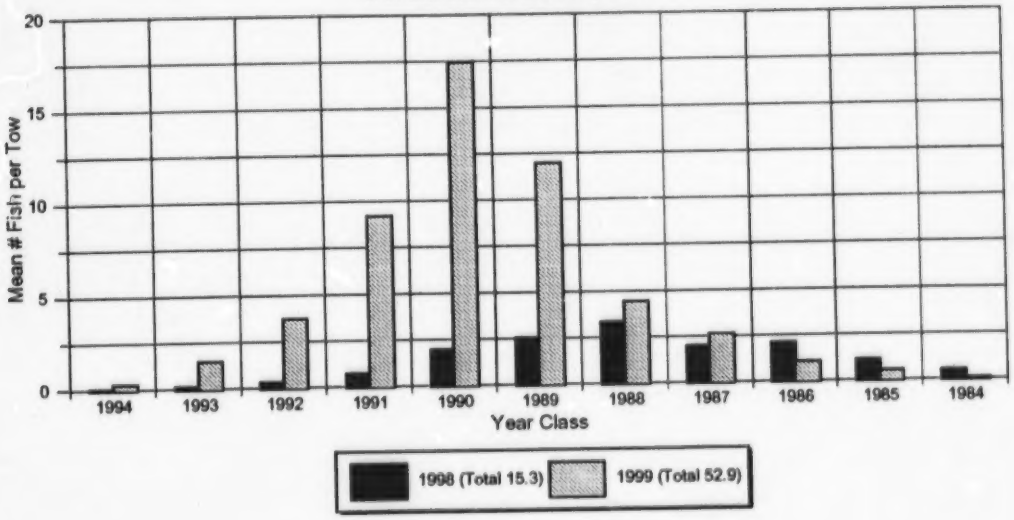


Figure 7b Year Class Composition
3Ps Plaice Est. % Total Mean #s/tow